

## Electrochromic Laminates For Advanced Spacesuit Visors, Phase I

Completed Technology Project (2018 - 2019)



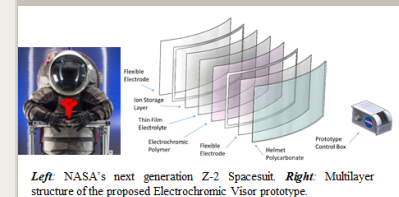
## Project Introduction

NASA's Extravehicular Mobility Unit, or EMU, is a personal mini-spacecraft that comprises the space suit assembly and life support systems. The current EMU has a manually operated extravehicular visor assembly (EVVA) that provides protection from micrometeoroids and from solar ultraviolet and infrared radiation. For the integration of EVVA with NASA's next generation space suits helmet bubble, dynamically switching technologies are needed to provide tint-ability, radiation protection, and optimized transmittance. Giner proposes to develop an electrochromic space suit helmet visor that would provide high optical contrast between its light (transparent) and dark (opaque) states, tunable switching, and a control module that would allow for both user and ambient light control. This electrochromic visor will provide >55% contrast at 550 nm, rapid switching, and low power requirements. Taking advantage of flexible transparent electrodes and a new generation of solution processable electrochromic polymers, Giner will develop and thoroughly test a prototype visor that meets or exceeds the performance and durability requirements listed by NASA. At the end of the program, a self-powered prototype visor integrated with a curved polycarbonate window will be delivered.

## Anticipated Benefits

The main application for our electrochromic polymer laminate is the EVVA Spacesuit Visor. Our device would allow the visor to instantly darken when exposed to sunlight or by user input to protect the astronaut's eyes from solar glare. In addition, our device could provide tunable change in transparency on windows used in space stations and vehicles, or on deep space shelters.

The ability to tune the color of helmet visors would be useful for military personnel such as aircraft pilots. There is also a broad range of civilian applications for our electrochromic polymer laminate including building windows, automotive glass, commercial aerospace, eye wear and helmet visors.



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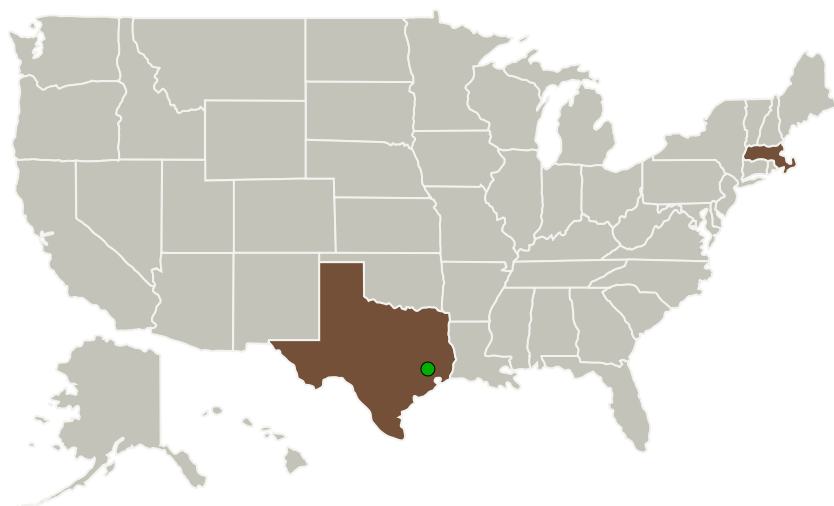
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Giner, Inc.	Lead Organization	Industry	Newton, Massachusetts
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Massachusetts	Texas

## Project Transitions

▶ **July 2018:** Project Start

✓ **February 2019:** Closed out

**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/141032>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Giner, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

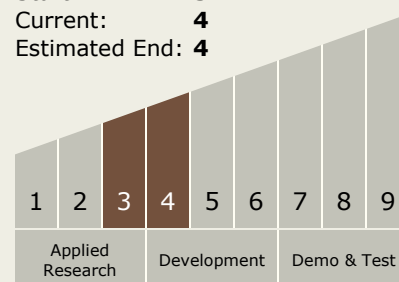
Carlos Torrez

**Principal Investigator:**

Avni Argun

## Technology Maturity (TRL)

Start: **3**  
Current: **4**  
Estimated End: **4**

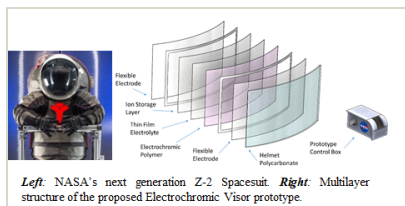


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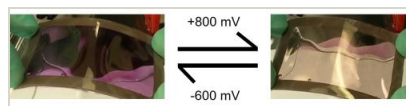


## Images



### Briefing Chart Image

Electrochromic Laminates For Advanced Spacesuit Visors, Phase I (<https://techport.nasa.gov/image/128558>)



**Final Summary Chart Image**  
Electrochromic Laminates For Advanced Spacesuit Visors, Phase I (<https://techport.nasa.gov/image/127211>)

## Technology Areas

### Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - └ TX06.2 Extravehicular Activity Systems
    - └ TX06.2.1 Pressure Garment

## Target Destinations

Earth, The Moon, Mars